

 Elevation



# ZwitterCo Elevation RO

Membranes with the highest  
resistance to organic fouling.

 ZwitterCo

# Overview

Reverse osmosis (RO) membranes are integral to industrial water treatment processes that require the highest levels of purification. However, traditional RO membranes struggle with rapid fouling in challenging environments affected by high organic content, which results in intensive maintenance, excessive downtime, and escalating operational costs.

In the past 40+ years, membrane development has led to only incremental improvements of commodity materials, and so the long-standing limitations on how membranes can be used have remained the status quo. But a new membrane chemistry has arrived, which was designed from inception to achieve unprecedented resistance to organic fouling. ZwitterCo Elevation RO membranes—built with innovative ZwitterShield™ technology—are redefining membrane performance with the highest permissible limits on COD, O&G, and TOC, significantly lower cleaning requirements, and the lowest overall cost of membrane operations.

# What's Included

- Common Challenges with Conventional RO Membranes
- Why ZwitterCo Membranes are Different
- ZwitterCo Membranes in Action
- Commercial Offering

## Chapter 1

# Common Challenges with Conventional RO Membranes

**Industrial processes involving high organic streams typically encounter persistent fouling that demands frequent membrane cleaning cycles**—sometimes as frequently as every few days. These repetitive cleanings not only drain operational budgets but also contribute to substantial downtime. Continuous exposure to harsh, specialized chemical formulations shortens membrane lifespan, further compounding operating expenses and complicating system management.

**Each cleaning cycle interrupts production, consumes operator time, and introduces safety risks associated with handling specialized chemical formulations.** Frequent membrane replacements significantly inflate capital expenditures (CAPEX) and complicate scheduling, further burdening operators. Moreover, traditional membranes struggle to maintain consistent permeate quality due to organic fouling, thereby increasing the complexity and cost of maintaining process reliability.

**Organic-rich feedwaters, characterized by elevated levels of Total Organic Carbon (TOC), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), and oil**

and grease, exacerbate these fouling issues. Conventional RO membranes often face rapid and irreversible fouling in such environments, necessitating frequent replacement or rigorous chemical treatments. Such scenarios also lead to higher operational pressures, increased energy consumption, and inconsistent permeate flow, impacting system efficiency and sustainability.

**These traditional approaches to membrane cleaning and maintenance fail to adequately mitigate the economic and operational challenges posed by high-organic streams, highlighting the critical need for more advanced and robust solutions.**

## DOWNTIME DUE TO Frequent Cleaning

RO membranes may be chemically cleaned to remove organic materials and recover performance. Cleaning, while necessary to maintain system performance, tends to heavily increase overall expenses. With each cleaning cycle requiring a temporary system shutdown, downtime from membrane cleaning can detrimentally affect operations.

Each time your system goes offline for a cleaning cycle, you sacrifice operator hours. This lost productivity can quickly add up.

## HIGH OPEX DUE TO Frequent Replacements

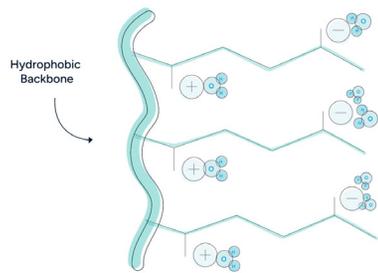
Every cleaning cycle chips away at the lifespan of your membranes, requiring you to replace your membranes more often. Whether planned or unplanned, the cost of new RO membranes can be a significant expense.

Frequent replacements not only increase overall costs but also contribute to additional downtime associated with installing and commissioning new membranes. Each replacement cycle requires taking the system offline, and frequent replacements often disrupt operations, leading to lost productivity on top of additional expenses.

If you are replacing your membrane **every two years or more frequently**, or cleaning **at least once a month**, expenses can add up quickly. Along with increased expenses, the downtime from cleaning and maintenance can disrupt production schedules and impact overall productivity.

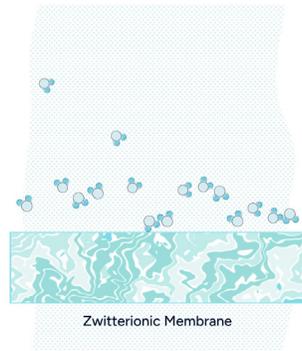
## Chapter 2

# Why ZwitterCo Membranes Are Different



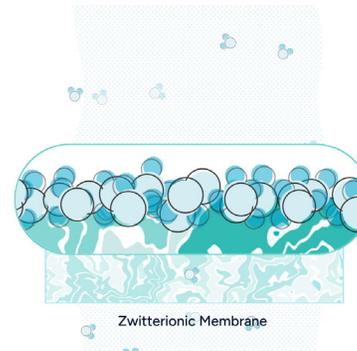
### Hydrophilic Structure

Membranes are built from interlocking zwitterionic copolymer chains, so the entire structure is hydrophilic.



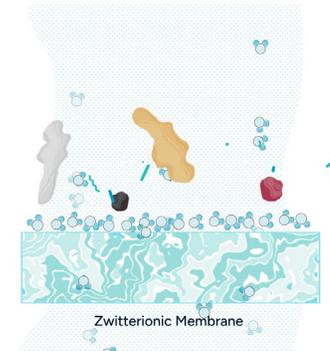
### High Permeability

Because of the hydrophilicity, the membrane is highly permeable to water and the structure stays fully hydrated.



### Fouling Protection

Water molecules form a barrier layer that protects the membrane from fouling. Organic compounds cannot adhere and are repelled from the surface.



### Easy Cleaning

The membrane resists foulant build-up during filtration and removes any aggregated material during cleaning faster and more easily than any other membrane.

## The Science

**ZwitterCo has set new standards in the membrane industry with** its innovative zwitterionic technology. With unmatched resistance to organic fouling, Elevation RO membranes represent ZwitterCo's next-generation membrane platform.

**Zwitterionic molecules contain positive and negative charges** in close proximity, which results in molecules that are extremely hydrophilic (e.g., "water-loving") and will interact with water like a salt or an electrolyte. In membranes built from zwitterionic

materials, the attraction between the zwitterions and water is so strong that a hydration layer or shell forms at the membrane surface and throughout the internal pore structure.

**This tightly-bound water layer prevents organic compounds** like oil and protein from contacting and sticking to the membrane, thereby preventing the permanent loss of performance that comes with organic fouling.

At ZwitterCo, we've developed **ZwitterShield™** and **ZwitterCore™** to leverage the power of zwitterions in two different membrane technologies:

## ZwitterShield™

Zwitterionic chemistry bonded to existing membranes. ZwitterShield™ enhances familiar membrane technology for the highest organics tolerance without requiring any changes to existing equipment or operating principles.

With ZwitterShield™, membrane users with known or expected organic fouling challenges will achieve:

- Reduced membrane operating costs
- Highest permissible limits for TOC, COD, O&G, & color
- Shorter or less frequent membrane cleaning programs
- Ability to use generic, inexpensive cleaning chemicals

## ZwitterCore™

Fundamentally new membranes where the zwitterionic layer performs the entire separation. ZwitterCore™ delivers powerful and unique performance that can unlock new wastewater or process solutions.

With ZwitterCore™, Operators with aggressive fouling challenges or that are looking to install filtration for the first time will achieve:

- Water reuse, regulatory compliance, or product concentration goals
- Membranes that handle up to 5% fats, oils, grease, and other organics
- Compatibility with chlorine to maximize speed, flexibility, and cost-efficiency during cleaning
- Ultra-high recovery solutions like Minimum or Zero Liquid Discharge (MLD, ZLD)



## Operational Benefits

ZwitterCo Elevation membranes offer unparalleled organic fouling resistance, reducing the frequency of high pH chemical cleaning by up to 90%. This means longer operational periods without the need for shutdowns and maintenance, enhancing overall system efficiency.



## Economic Benefits

The economic advantages of ZwitterCo Elevation RO membranes are substantial long-term. By reducing cleaning frequency and enabling the use of generic cleaners over specialty, formulated chemicals, Elevation RO elements operate longer and can slash your chemical and wastewater budget, lowering overall operating costs.

Not only can Elevation RO membranes reduce your overall operating expenses (OPEX) by at least 50%, they are also designed to be drop-in replacements, offering a no-risk opportunity for users to upgrade their system and lower costs without additional capital expenditure (CAPEX).



## Adaptability Benefits

ZwitterCo Elevation RO membranes have the industry's highest feedwater guidelines for organic compounds like TOC, COD, and O&G. This provides a higher margin of safety in more challenging applications and higher reliability when the water quality fluctuates or if there is a spike in upstream contaminants.

### Industry Leading Organic Tolerance

Parameter	Optimum Membrane Performance	Differentiated Membrane Performance	Maximum Allowable
TOC (mg/l)	< 15 mg/l	< 50 mg/L	Consult ZwitterCo
COD (mg/l)	< 50 mg/l	< 200 mg/L	
O&G (mg/l)	< 2.5 mg/l	< 10 mg/L	

## Chapter 3

# ZwitterCo Membranes in Action

## 01. Improved RO Reliability for Complex Leachate

A landfill leachate treatment facility in Sytraival, France, was experiencing significant operational challenges due to the complex and variable composition of the wastewater, which included elevated levels of organic compounds, nitrogen species, heavy metals, and inorganic salts. Conventional BWRO membranes suffered from **rapid fouling**, requiring daily clean-in-place procedures and element replacement every three to four months.

Various cleaning agents and alternative membranes were trialed but failed to deliver lasting improvement, resulting in high chemical consumption, increased operating costs, and system downtime. In early 2024, a membrane evaluation was

initiated to assess the performance of **ZwitterCo Elevation High Rejection BWRO** membranes under standard site conditions and without modifying system design or control strategy. The ZwitterCo membranes were installed in one pressure vessel for side-by-side comparison with incumbent elements operating under identical feed and hydraulic conditions.

The membranes demonstrated stable flux, improved cleanability, and strong contaminant rejection across critical leachate constituents. Following performance validation, the full system was converted. Cleaning frequency dropped from 7 to 4 times per week using a simplified protocol, reducing chemical usage, cleaning water consumption, and membrane replacement frequency. Cleaning-related operating costs were reduced by ~50% per m<sup>3</sup>, and treated permeate consistently met reuse targets for non-potable applications such as truck washing and dust suppression.

The evaluation confirmed that ZwitterCo Elevation elements deliver long-term process stability and cost-efficiency under demanding landfill leachate conditions.

### KEY HIGHLIGHTS

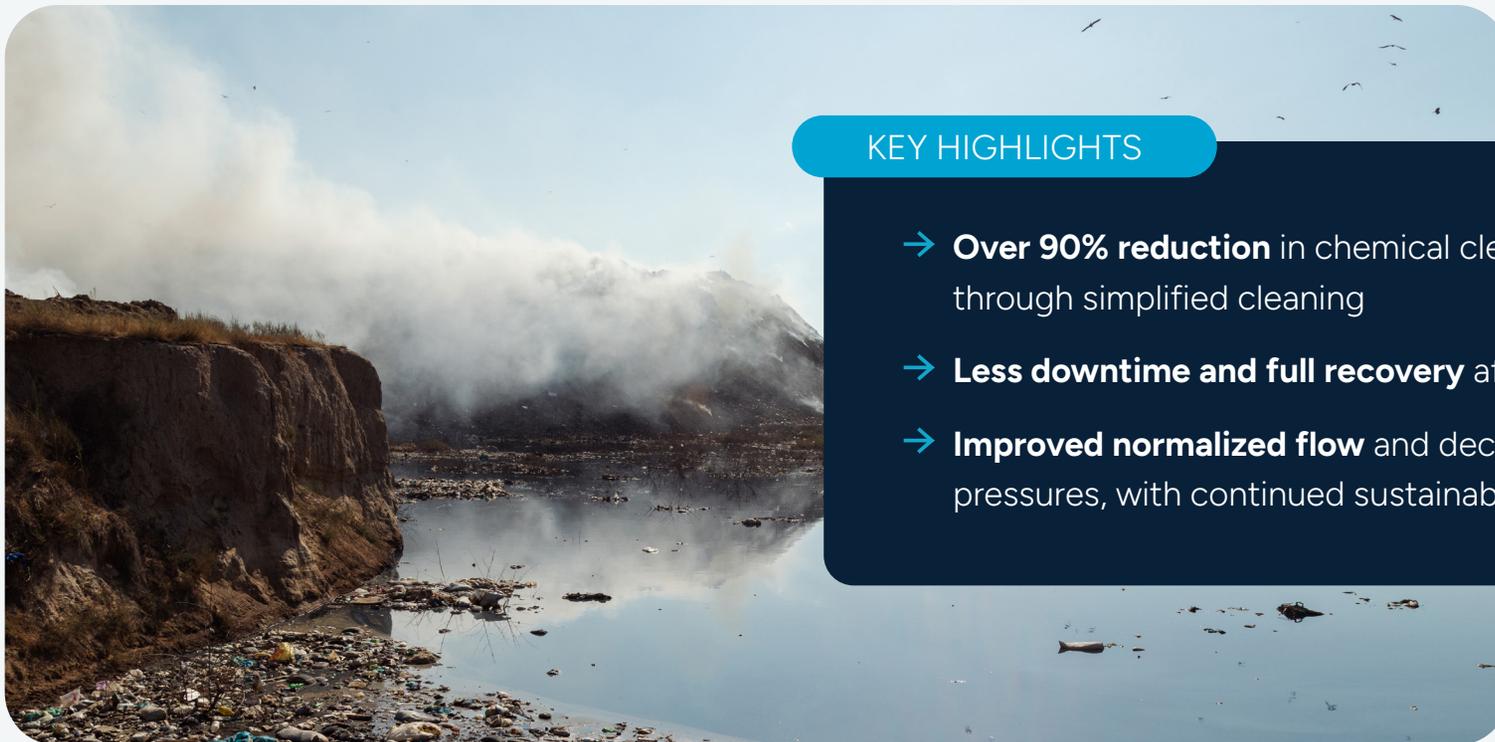
- Operational for >1 year with **strong performance**
- **~50% reduction** in cleaning cost per m<sup>3</sup>
- Cleaning water usage **reduced by 43%**

## 02. Tackling Leachate Challenges at a Southwestern European Landfill

A landfill in southwestern Europe was experiencing ongoing operational and financial strain while managing high-strength leachate. The site's first-pass reverse osmosis (RO) system required frequent cleanings using costly formulated chemicals, which drove up expenses and slowed down operations.

To address these challenges, the site installed ZwitterCo Elevation RO membranes in the first-pass position. Specifically built for challenging leachate applications, the membranes were easy to install and have provided consistent, reliable performance through four months of continuous operation.

The commercial rental has already demonstrated meaningful operational and economic benefits. Chemical cleaning costs have been slashed by more than 90% through simplified, more effective cleaning protocols. Unlike traditional membranes, ZwitterCo's technology consistently recovers fully after each cleaning cycle, reducing downtime and enabling continuous, reliable throughput. In parallel, the system has shown improved normalized flow and a steady decline in operating pressures—early indicators of sustainable membrane health and long-term viability. Based on these results, the operator placed a large follow-on order for a 300 m<sup>3</sup>/day installation.



### KEY HIGHLIGHTS

- **Over 90% reduction** in chemical cleaning costs through simplified cleaning
- **Less downtime and full recovery** after each clean
- **Improved normalized flow** and decreasing operating pressures, with continued sustainable performance

### 03. Food & Beverage Wastewater Treatment

A food and beverage facility in Europe faced a challenge treating wastewater that was high in organics, including COD, BOD, and residual proteins. The system required a solution that could reliably handle difficult effluents and reduce the strain on downstream processes.

The facility piloted ZwitterCo membranes on several wastewater streams to identify the best solution. Both ZwitterCo Elevation™ RO and Expedition™ SF were tested, and the site selected Elevation RO membranes for full-scale operation. Equipped with ZwitterShield™ organic fouling resistance, the membranes were integrated into a system consisting of drum screen pretreatment, ultrafiltration, and ZwitterCo RO.

The installation consistently treated wastewater with up to 30,000 ppm COD in the feed, producing permeate with less than 4,000 ppm COD. Operators reported successful cleanings using only commodity chemicals, which reduced costs compared to formulated cleaners, and the membranes required fewer cleanings overall.

The system also achieved over 70% recovery, which meant that a significant portion of water was removed from the biogas process. The treated water was then polished through a biological filter and ecological wetland, enabling clean discharge to the river.

	RO Feed	RO Permeate	Membrane Rejection (70% recovery)
COD (ppm)	34,000	3740	95%
TDS (ppm)	18,223	1635	96%

#### KEY HIGHLIGHTS

- Wastewater up to 30,000 ppm COD treated to <4,000 ppm COD permeate
- Over 70% recovery, reducing water load to the biogas plant
- Cleaning with commodity chemicals, lowering cost and frequency

## Chapter 4

# Commercial Offering

## Elevation

ZwitterCo Elevation RO membrane elements are available in standard 8040, 4040, and 2540 sizes across three commercial variants: High Rejection BWRO, Low Energy BWRO, and High Pressure RO. These elements are typically available from stock or with short lead times to support rapid deployment and system replacements.



# Conclusion

The introduction and adoption of new membrane chemistry is critical to make real change in the water industry, and as we often say – every industry is a water industry. This new era of membrane technology will enhance efficiency, sustainability, and cost-effectiveness, setting a new standard for water treatment and reuse.

ZwitterCo's innovative membranes are at the forefront of this change, offering solutions that are not only more effective, but also more resilient. If you are interested in discovering how much your operation could save by switching to ZwitterCo membranes, we invite you to contact us directly for more information.



# ZwitterCo

ZwitterCo is the global leader in membrane solutions for challenging separations, helping industries treat complex wastewater, purify water for reuse, and maximize efficiency in food processing applications. The company leverages its breakthrough zwitterionic chemistry to build membranes with unprecedented fouling resistance, overcoming the longest-standing limitation with conventional filtration. Manufacturers in more than 20 countries across food and beverage, agricultural, and industrial sectors rely on ZwitterCo's membrane solutions to achieve their most ambitious sustainability and growth targets.

## ZwitterCo

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